



ENVIRONMENTAL UNIT

King County Department of Transportation
Road Services Division, Engineering Services Section

Mission Statement: We preserve and promote environmental integrity in the design, construction and maintenance of transportation systems that serve the needs of the community.

King County Department of Transportation Guideline for Use of Recycled Concrete Material as Fill

Purpose

This document provides guidance on the appropriate situations where Recycled or Reclaimed Concrete Material (RCM) can be used in King County Road Services projects. This material is considered a product and not a waste by the Washington Department of Ecology and King County Department of Natural Resources and Parks and both agencies have reviewed this document. However, RCM does have a very high pH and water quality can be adversely impacted if the material is not properly sited and managed.

Background

Use of Recycled or Reclaimed Concrete Material (RCM) in transportation projects has many advantages for saving resources and using a waste product that might normally be placed in a landfill. Standard Specifications allowing the use of RCM have been developed and adopted by Washington State Department of Transportation (WSDOT) and King County (9-03.21(3) Recycled Portland Cement Concrete Rubble). Certain constraints to using RCM exist and should be considered in the environmental and design phases of project development.

Recycled Concrete Material

Concrete can be crushed and reused as fill and aggregate material. The procedure involves (1) breaking up and removing the old concrete, (2) crushing in primary and secondary crushers to create the necessary size ranges, (3) removing reinforcing steel and embedded items, (4) grading and washing (not always done), and (5) finally stockpiling. The resulting coarse and fine aggregate are allowed by Section 9-03.21(3) of the WSDOT Standard Specifications for use in ballast, shoulder ballast, crushed surfacing, aggregate for gravel base, gravel backfill for foundations, gravel backfill for walls, gravel backfill for pipe zone bedding and drains, backfill for sand drains, sand drainage blanket, gravel borrow, select borrow, common borrow, foundation material, and bank run gravel for trench backfill.

Water Quality

Some of the initial reactants in portland cement concrete¹ will be present in the concrete aggregate material. In the presence of water these left over reactants will dissolve into solution. The pH of leachate from this material is generally in the 11 to 12 range (highly basic or alkaline) (Chester Engineering 2001).

- Testing by the Ohio Department of Transportation found that RCM aggregate soaked in water for 63 days caused the water to attain a pH of 9 to 12 and higher. In one trial the water was changed three separate times and still attained pH above 10 each time. Mixing the RCM with limestone lowered the pH of the water.
- Florida DOT, Illinois DOT, New Jersey DOT, and New York State DOT all restrict the use of RCM as aggregate to two to three feet above ground water. Some states also restrict the use of RCM around metal pipes due to the corrosive nature of water leachate.
- A study by Federal Highway Administration (Sept. 2004) promotes the use of RCM but notes that: "Leaching questions when RCA (recycled concrete aggregate) is used in a drainage layer, or near a water source need to be answered."
- While conventional asphalt and concrete road surfaces limit infiltration into the road prism, water does enter and move through road fill;
- Metal testing (Federal Leaching Test) by LaFarge of slag/concrete material did not detect soluble metals in leachate.

Additional research is currently underway by the Recycled Material Research Center at New Hampshire University and may help determine with more certainty the potential impact of high pH material on water moving through the road environment.

King County Code (Section 9.12, Surface Water Management, Water Quality) prohibits the discharge of contaminants, including bases, to surface water.

Washington water quality rules establish pH rules for water. Washington Administrative Code (WAC 173-201A Water Quality Standards for Surface Waters of the State of Washington) establishes Aquatic Life pH Criteria in Fresh Water for salmon and trout as follows: "pH shall be within the range of 6.5 to 8.5, with a human-caused variation within the above range of less than 0.2 units or 0.5 units depending on the type of fish habitat."

The Federal Environmental Protection Agency secondary drinking water standard is a pH range of 6.5 to 8.5. This is also the pH range allowed for groundwater in WAC 173-200, the code section referred to for inert landfill performance standards.

¹ ASTM C 150 defines portland cement as "hydraulic cement (cement that not only hardens by reacting with water but also forms a water-resistant product) produced by pulverizing clinkers consisting essentially of hydraulic calcium silicates, usually containing one or more of the forms of calcium sulfate as an inter-ground addition."

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In summary, the research that is available notes that high pH leachate from RCM is an issue; RCM leachate is corrosive to metal, especially aluminum and galvanized pipe; which can be an issue for utilities and calcium carbonate deposits leaching out of RCM have been found in culverts. Finally, as noted above, State rules preclude altering river water pH levels within a narrow range. A file containing currently available reports is in the Environmental Unit library under the heading "Recycled Concrete Material."

WAC and King County Health Code

Cured concrete, when disposed of as a waste, is defined as an inert waste (WAC 173-350-990 and King County Title 10). However, concrete as a recycled product is not a solid waste (DOE, email communication). The inert waste rules do provide guidelines for the placement of RCM. Given the potential water quality issues associated with RCM, these placement rules will be adopted for use of RCM in road construction.

Do not use RCM in the following locations:

- on unstable slopes,
- within 10 feet of the property line,
- closer than 100 feet from a water well or over a critical recharge area,
- in a channel migration zone,
- within a floodway where material may be saturated or within 100 feet of a stream, lake, pond, river, or saltwater body,
- any wetland,
- as backfill around metal utilities or culverts,
- under pervious pavement.

NPDES General Construction Permit

Beginning October 1, 2006, the new Construction Stormwater permit requires projects which disturbance of 1 acre or more and use greater than 1000 cubic yards of recycled concrete must monitor stormwater runoff weekly for pH when the RCM is exposed to precipitation. If pH levels exceed 8.5 the stormwater must be prevented from discharging to surface water and stormwater must be treated. Please see the general permit for complete requirements.

SEPA Considerations

To ensure that the issue of using RCM has been addressed during SEPA environmental review, add language to SEPA documents that recycled concrete materials may be used in a project.

Suggested Language: Recycled materials such as concrete, glass and asphalt may be used in the project as aggregate or fill products. Use of these materials will be in accordance with Washington Administrative Code and Title 10 King County Board of Health Solid Waste Regulations.

Cautions and Conditions on use of Recycling Special Provisions (RSP) in Projects

The Washington State Department of Transportation Standard Specifications for aggregate type material (9-03.21(3) Recycled Portland Cement Concrete Rubble) allow the use of RCM as ballast, shoulder ballast, crushed surfacing, aggregate for gravel base, gravel backfill for pipe zone bedding and drains, backfill for sand drains, sand drainage, borrow, foundation material and trench backfill.

Research by several state departments of transportation has raised issues with pH leachate and creation of Tufa (brittle, porous, spongy rock made of calcium carbonate) like deposits. Due to its high alkalinity, RCM in contact with aluminum or galvanized steel pipes can cause corrosion in the presence of moisture.

Precautions for the use of RCM:

- Limit the use of RCM to 3 feet above high ground water.
- Tufa like mineral deposits may affect the permeability of geotextiles, gravel drain fields, and drain field piping. Potential clogging of these areas is possible and any proposed use by the contractor should be evaluated by ASTM standards.
- As noted before, RCM should not be used on projects where fill will be placed within 100 feet of wetlands, streams, or rivers, in channel migration areas, or private wells. Stockpiles should also not be placed in or within 100 feet of these areas.
- Careful consideration of subsurface conditions should be given before using RCM within 1000 feet of wells, critical aquifer recharge areas, aquatic areas, and wetlands. Depth to groundwater, direction of groundwater flow, and subsurface material permeability should be evaluated to determine potential for adverse impacts to water quality.

Deleting or modifying the RSP to restrict the use of RCM may be needed for areas of high groundwater, aquatic areas, and wells. Bridge projects may not be suitable for the use of RCM because of their proximity to aquatic areas.

Hazardous Waste and Contamination Cautions:

Some concrete has been painted with lead based paint or may have surface contamination from oil and grease. The RSP requires the contractor to certify that the recycled material is not a Washington State Dangerous Waste (WAC 173-303) and test for hazardous constituents at a frequency of one per 10,000 tons. RCM should also be visually inspected as it is brought to the site to look for painted surfaces or staining. Test results should be kept on file to demonstrate that contaminants are not present in RCM.

Document Updates

This document was compiled by Julia Turney (julia.turney@metrokc.gov). Please direct any comments or questions regarding this document to KCDOT-RSC-ES at (206) 296-6520

References

AASHTO Standard Specification for Unbound Soil-Aggregate Base Course, AASHTO Designation M 319-02, online reference June 2006
<http://www.rmrc.unh.edu/Research/Rprojects/Project13/Specs/RCGB/reconconbase.pdf>

Aupl, Gardner, Eighmy Benoit, and Brannaka, Feb. 2002, Review of Water Movement in the Highway Environment, Implications for Recycled Materials Use, Recycled Materials Research Center, Univ. of New Hampshire, 93 pages.
<http://www.rmrc.unh.edu/Research/Rprojects/Project7/review/watermovement.pdf>

Acosta, Greg, April 29, 2005, Report of Findings- State-wide Portland Cement Concrete Waste, Supplemental Report, for California Department of Transportation, available online at: <http://www.dot.ca.gov/hq/env/haz/index.htm>

Chester Engineering, July 2001, White paper and Specification for Reclaimed Concrete Aggregate for Unbound Soil Aggregate Base Course, Project 13 Development and Preparation of Specifications for Recycled Materials in Transportation Applications, Univ. of New Hampshire, 17pages.

Christiansen, Peter, and Krafft, Albert, October 26, 2004, Washington Department of Ecology Solid Waste and Financial Assistance Program, email communication.

Federal Highway Administration, September 2004, State of the Practice National Review, Transportation Applications of Recycled Concrete Aggregate, 34 pages.

King County Department of Public Health, 2003, Title 10 of the Code of the King County Board of Health, King County Board of Health Solid Waste Regulations.
http://www.metrokc.gov/health/boh/reg0306_solidwaste.pdf

King County Public Rules and Regulations, Public Rules, Title: Waste Acceptance Rule, Document Code No.: PUT 7-1-4 (PR)

King County Internet Website, King County Environmental Purchasing Program, Recycling Concrete Aggregate, <http://www.metrokc.gov/procure/green/concrete.htm> and Recycled Roadway Materials, <http://www.metrokc.gov/procure/green/bul46.htm>

Mulligan, Sean, June 14th, 2002, Recycled Concrete Materials Report, Ohio Department of Transportation, 21pages.<http://www.dot.state.oh.us/testlab/In-House-Research/consolidated%20results%20of%20RCM%20tests.PDF>

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National Pollutant Discharge Elimination System (NPDES) and State Waste Discharge General Permit for Stormwater Discharges Associated With Construction Activity, State of Washington Department of Ecology, Olympia, Washington 98504-7600
http://www.ecy.wa.gov/programs/wq/stormwater/construction/construction_final_permit.pdf

Recycled Material Resource Center
<http://www.rmrc.unh.edu/Resources/PandD/RCAREport/RCAREPORT.pdf>

Trohimovich, Jill, October 6, 2004, King County Department of Public Health, email communication.

User Guide to use of waste and byproduct materials in pavement construction, FHWA, on line manual found at <http://www.rmrc.unh.edu/Partners/UserGuide/index.htm>